Monday, September 18, 2017 1:39 PM

IA - Due Oct 2 11:59 PM
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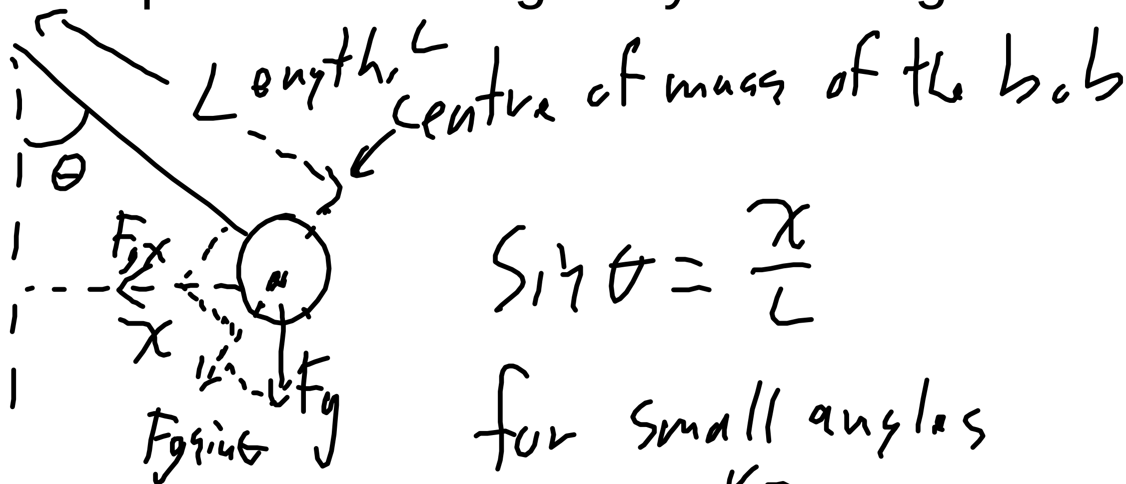
ID: 16307795
key: Physics

Simple Harmonic Motion Intro
capstone
F-t, x-t, v-t, a-t, F-x graphs (calculus much?)
Textbooks

Simple Harmonic Motion, SHM

Restoring force, F, is proportional and opposite the displacement, x.
eg. Hooke's Law $F_{elastic}=-kx$ where k is the elastic constant
or pendulum, the displacement of the bob results in a component of the gravity restoring



$\sin\theta = \frac{x}{L}$

for small angles

$F_{gx} \sim kx$

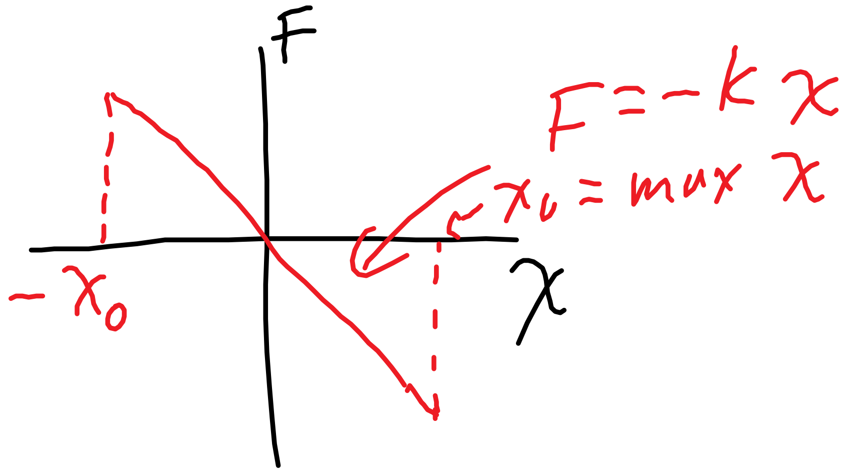
↑ constant

$F_g \sin\theta$

'constant'

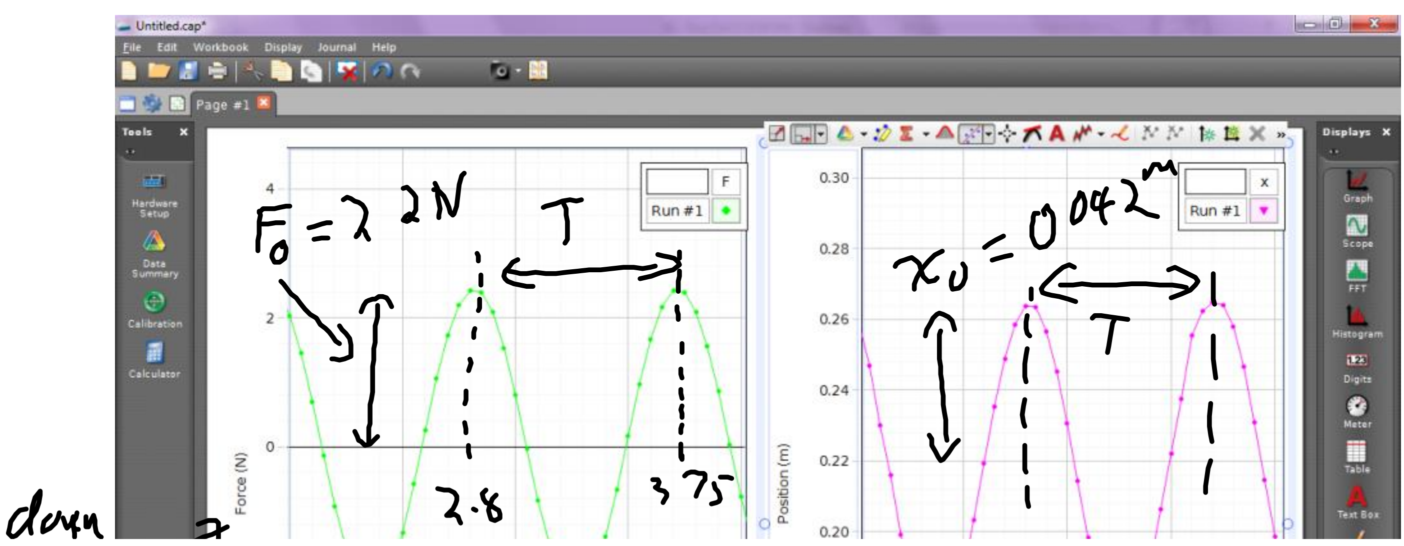
$F_x \propto x$

What will our F vs x graph look like from SHM?

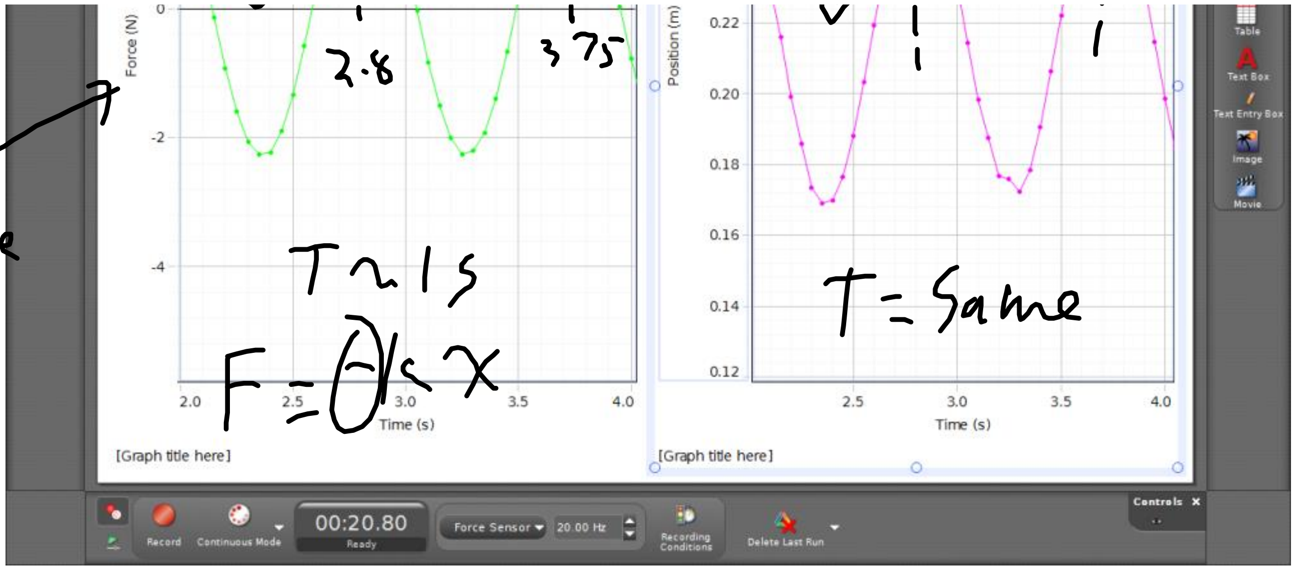


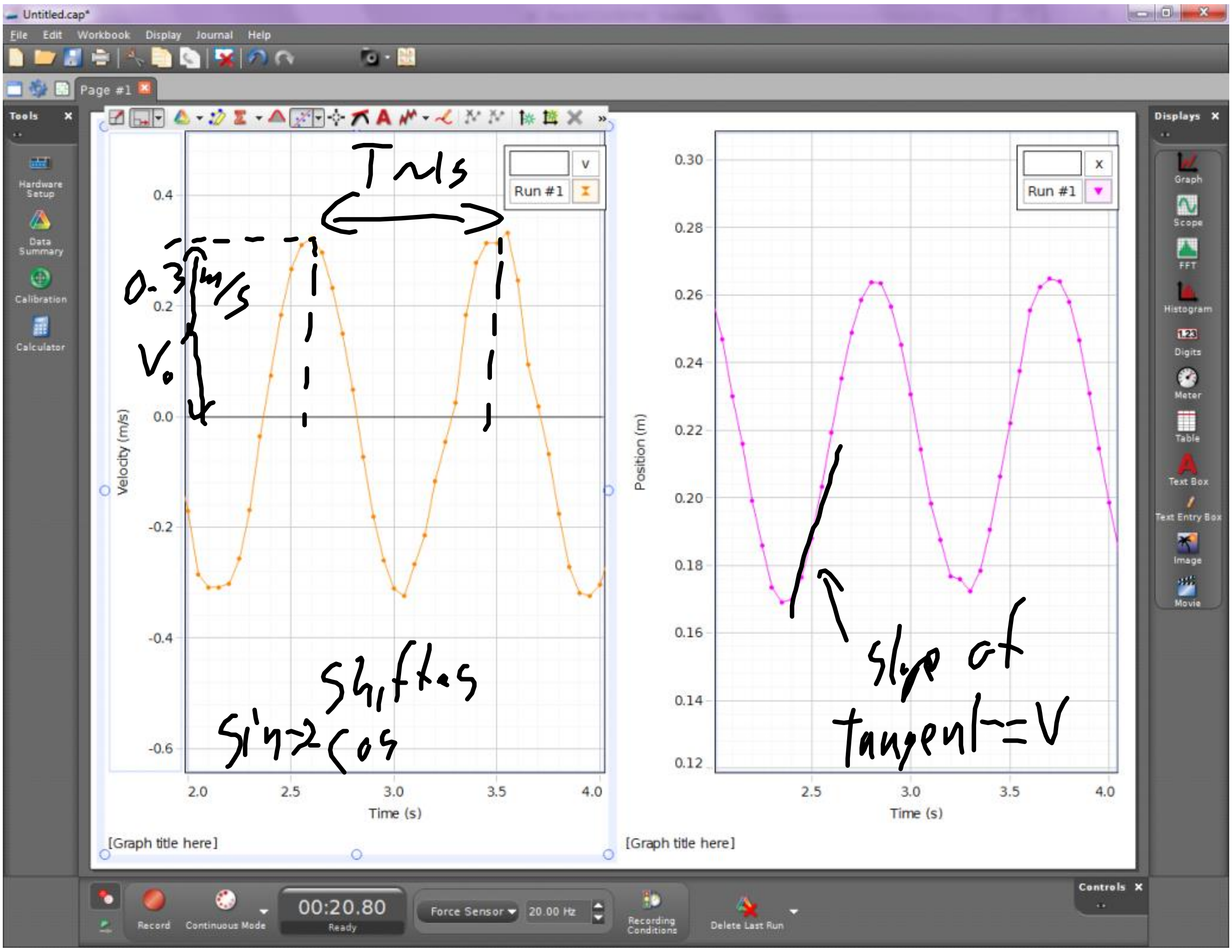
Spring length = 20.0 cm with no mass
= 39.0 cm with 500g suspended.

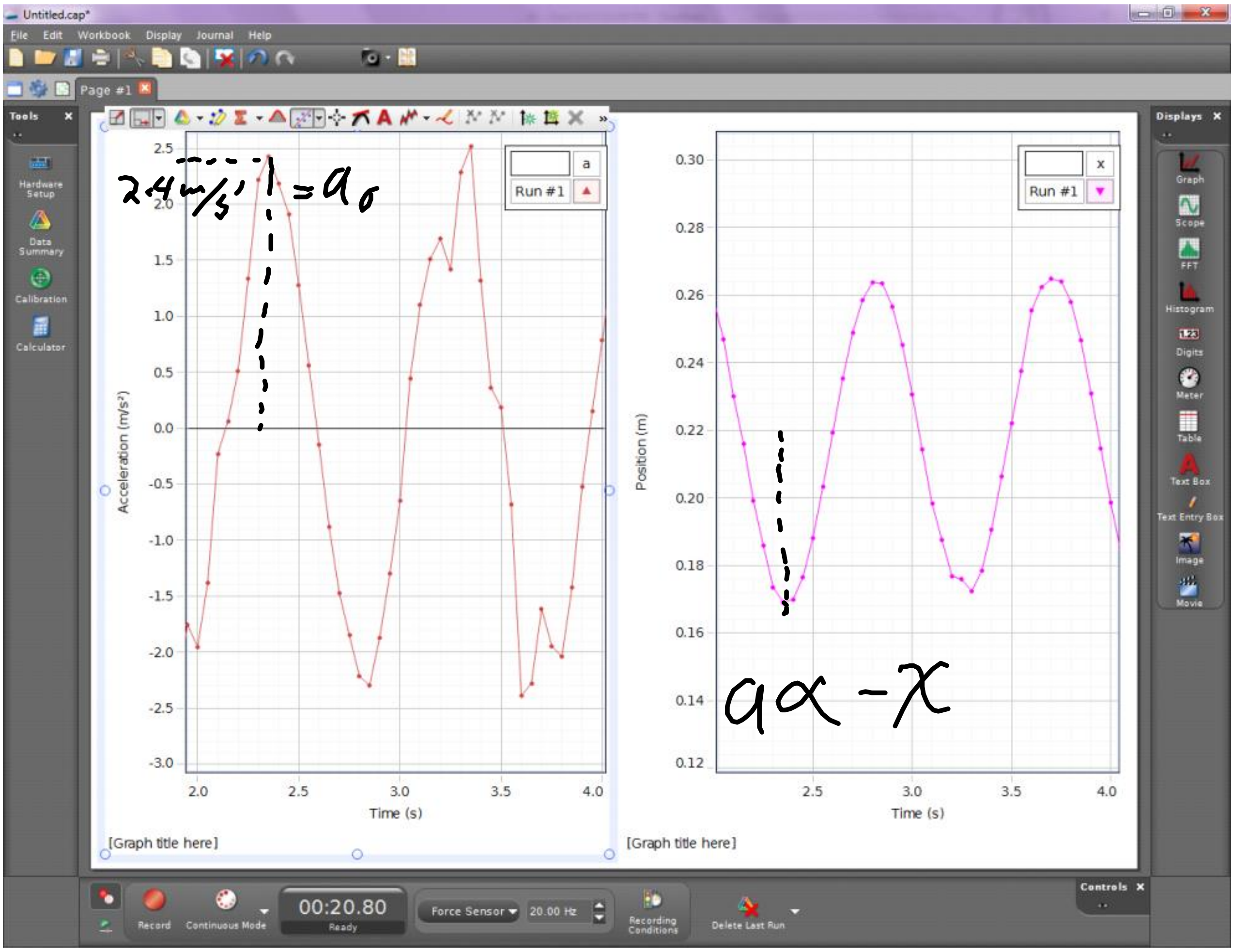
What is the spring constant?
What is the force on the mass if you pull the mass down 2.0 cm (more) and let go?
What will the x-t, v-t, a-t, and F-t graphs look like?



down F is positive







big idea: F-t, x-t, v-t and a-t graphs are sinusoidal, with the same period, T

angular frequency, $\omega = 2\pi f$ where $f=1/T$

$x = x_o\sin\omega t$ or $x_o\cos\omega t$ (data booklet)

calculus people

v= first derivative of x

$v = x_o\,\omega\cos\omega t = v_o\cos\omega t$ or $-x_o\,\omega\sin\omega t = -v_o\sin\omega t$

(phase shift $x = x_o\sin(\omega t+\phi)$)

big idea: $v_o = x_o\,\omega$

$a = -x_o\,(\omega)^2\sin\omega t = a_o\sin\omega t$ or

$-x_o (\omega)^2 \cos\omega t = a_o \cos\omega t$

big idea $a_o = -x_o (\omega)^2$

But F=ma so $F_o = -m x_o (\omega)^2$

and $F_o = -k x_o$

$-m x_o (\omega)^2 = -k x_o$

$(\omega)^2 = k/m$

$$\omega = \sqrt{\frac{k}{m}}$$

$$2\pi f = \sqrt{\frac{k}{m}}$$

$$\frac{2\pi}{T} = \sqrt{\frac{k}{m}}$$

$$\boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$

So, for the 0.50 kg mass, predict the period fo oscillation of the mass on the spring.

Giancoli: p302 Questions 1-7 odds, P303 Problems 1, 3, 7, 11, 15, 19, 23

Energy of a spring: $1/2kx^2$ = elastic energy

next class SHM energies